

Chaos under canvas: a *Salmonella enteritidis* PT 6B outbreak

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SUMMARY

An outbreak of *Salmonella enteritidis* PT 6B food poisoning, the first reported of this recently described phage type, resulted in illness among 46 of 49 members of a camping group in North Wales, 33 of whom were hospitalized. Epidemiological evidence ($P < 0.0001$) indicated that a lemon meringue pie was the vehicle of infection. Fresh shell eggs, stored after purchase at ambient temperature, appear to be the most likely source of infection, with multiplication during preparation and subsequent storage of the pie a significant contributory factor. Campers may be at greater risk than others and should consider the use of cold boxes for the transport and storage of eggs, and avoid the preparation of lightly cooked egg products under these basic conditions.

INTRODUCTION

The association of outbreaks of gastroenteritis due to *Salmonella enteritidis* with the consumption of eggs or unpasteurized egg products is well recognized [1]. Eggs or egg dishes have often been implicated as vehicles of infection in outbreaks [2–6], and in case control studies [e.g. 7]. The organism can survive light cooking [8], and the ACMSF (Advisory Committee on the Microbiological Safety of Food) have made recommendations about the refrigerated storage of eggs and have drawn attention to the risk associated with eating raw and lightly cooked eggs [1]. While efforts to minimize risk have been directed at the likely source and vehicles of infection and the importance of food preparation and cooking practices [1], especially in the catering industry, less attention has been given to identifying other high risk situations for the public.

Groups on camping holidays or living in basic ‘field conditions’, where the maintenance of food storage, preparation and cooking standards can be difficult, may be at greater risk of food and water-borne disease. Gastroenteritis under such conditions, especially sporadic cases, may often be discounted as ‘travellers

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diarrhoea'. In the 12 months to September 1994, of 71 outbreaks of salmonella reported in England and Wales, 2 occurred among groups who were camping and a further 3 among the armed forces [9, 10]. Four of the 5 were among the 20 reported outbreaks where more than 20 people fell ill. This paper reports a major outbreak of *Salmonella enteritidis* phage type (PT) 6B gastroenteritis which occurred among members of a Boys and Girls Brigade Group on a week's camping holiday in North Wales in August 1994. This is the first outbreak of this recently described phage type to be described. Recommendations to reduce the risk of further outbreaks of this kind are made.

MATERIALS AND METHODS

There were 49 camp members, comprising 12 adults and 37 children (ranging from 9–17 years of age). They brought with them from their home town, 300 miles away: tents, ovens, cooked and uncooked foodstuffs, but no refrigeration facilities. Three days after arriving at the camp site, 46 individuals became ill with symptoms of gastroenteritis, 36 within a 24-h period. In all, 33 subjects were hospitalized, requiring a fleet of ambulances. Thirty-one needed hydration with intra-venous fluids.

Faecal samples from all camp members and uncooked foodstuffs were examined for bacterial pathogens. Camp leaders and those involved in food preparation were interviewed and a structured questionnaire was administered to all 49 of the group. Questions were based on a complete menu of foods consumed, and on other risk activities undertaken, prior to the outbreak. Unfortunately, all cooked food, including the remains of the suspect meal consumed the evening before the onset of symptoms, had been discarded and were not available for testing. Faecal samples were tested at Bangor Public Health Laboratory (PHL) and phage typing was performed at the Laboratory of Enteric Pathogens (LEP), Central Public Health Laboratory, Colindale [11]. Between 2 and 4 weeks after the outbreak, a telephone survey of families of camp members was conducted to identify if there had been any secondary household spread. For epidemiological purposes the following case definition was used: diarrhoea (3 or more loose or watery stools in 24 h), or vomiting, or abdominal pain, in a camp member, between 1 and 5 August 1994.

RESULTS

Epidemiology

Forty-six of the 49 camp members met the case definition, reporting diarrhoea, vomiting, or abdominal pain. The results of one 11-year-old who reported symptoms prior to the suspect meal were excluded from further analysis. The onset of reported symptoms were diarrhoea (41/45), abdominal pain (42/45), fever (39/45), vomiting (35/45) and headache (35/45). Figure 1 shows the incubation period from the suspect meals to the onset of symptoms. The mean incubation period was 20 h, with a median of 18 h. Attack rates for the principal foodstuffs consumed on 31 July and 1 August are presented (Table 1).

The association of two endpoints, illness and faeces positive for *Salmonella enteritidis* PT 6B, were tested with each food, and with other risk factors. The only

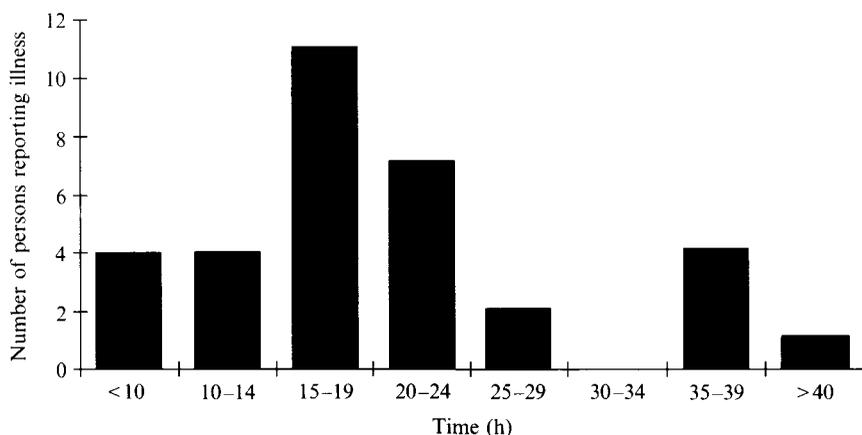


Fig. 1. Incubation period (period from suspect meal to onset of symptoms).

Table 1. Attack rates by food consumed

Food	Ate food			Did not eat food			Relative risk	95% conf. interv.
	Ill	Total	Attack rate (%)	Ill	Total	Attack rate (%)		
Monday 1 August								
Lemon meringue	42	42	100	3	6	50	2.0	0.9-4.5*
Shepherds pie	45	48	94	0	0		N.A.	N.A.
Carrots	34	36	94	11	12	92	1.0	0.8-1.2
Mashed potato	42	45	93	3	3	100	0.9	0.9-1.0
Cakes	34	36	94	11	12	92	1.0	0.8-1.2
Porridge	38	40	92	7	8	87	1.1	0.8-1.4
Beans and toast	34	37	92	11	11	100	0.9	0.9-1.0
Sandwiches	36	39	90	9	9	100	0.9	0.8-1.0
Water	39	42	93	1	1	100	0.9	0.9-1.0
Sunday 31 July								
Yorkshire pudding	41	43	95	4	5	80	1.2	0.8-1.9
Salad	34	37	92	11	11	100	0.9	0.8-1.0
Salad cream	21	22	95	24	26	92	1.0	0.9-1.2
Chopped ham/pork	31	34	91	14	14	100	0.9	0.8-1.0
Turkey roll	34	38	89	10	10	100	0.9	0.8-1.0
Fried eggs	35	36	97	10	12	83	1.2	0.9-1.5
Peas	31	33	94	14	15	93	1.0	1.0-1.2

* $P < 0.05$.

significant exposure was the consumption of lemon meringue pie (Table 2). Everybody (42/42) who ate lemon meringue pie became ill, and salmonella was isolated from the faecal samples of all but one of them (41/42). That person reported eating only 3 or 4 spoonfuls (approximately a quarter portion) and her faeces were not tested until 5 weeks after the outbreak. Neither the occurrence nor the severity of illness was associated with age or sex. Of the 6 persons who did not consume the pie, 3 (all children) reported illness, but all 6 of these had negative faecal results. The one case excluded from the analysis, because of early onset of illness, had consumed lemon meringue pie and had salmonella in her faeces. The

Table 2. Association of (a) salmonella and (b) illness with eating lemon meringue pie

	Salmonella in stool		Reported illness		Total
	Yes	No	Yes	No	
Ate lemon meringue pie					
Yes	41	1	42	0	42
No	0	6	3	3	6
Total	41	7	45	3	48
Relative risk	N.A.		2.0		
Confidence interval (approx.)	N.A.		0.9-4.5		
χ^2 (Yates corrected d.f. = 1)	32.7		14.7		
P value (Fisher exact 2-tail)	< 0.001		0.001		

telephone survey revealed no secondary spread of infection to 76 contacts in the 32 households to which all the camp members returned. All 46 who had been ill made a full recovery.

Environmental results

The lemon meringue pie was made from 20 shell eggs, pastry (lard, margarine and flour), sugar and lemon mix dry powder. The eggs were from a batch laid 13 days before the outbreak, purchased in the camp members' home town, and transported to the camp in North Wales and stored there unrefrigerated, in warm summer temperatures, 2 days before the preparation of the pie. Two farms were identified from which the eggs used in the preparation of the lemon meringue pie originated. Tests on dust samples from the farms failed to identify the organism, but the poultry flocks were not tested for this unusual phage type.

Food preparation histories suggested that cross-contamination from other foods was unlikely. The ingredients and preparation of the lemon meringue pie were kept separate from other foods and foodstuffs used in the preparation of the suspect meal, including the shepherd's pie. The two cooks became ill at the same time or later than the rest of the camp, making it unlikely that they were the source of infection.

The preparation of the pie involved adding egg yolks from 20 eggs to the lemon mix powder and this mixture was brought to the boil for 1-2 min. The mixture was poured into a pastry base and left covered to stand for 4 h at ambient temperature. At this point the meringue topping was made, using egg whites which had been standing for 4 h. and was added to the lemon pie and placed in the oven at gas mark 6 for between 5 and 10 min to brown. On removal from the oven, the pie was left at ambient temperature for a further 2-3 h before being consumed. Examination of the three gas ovens showed that they were functioning properly but their small size may have been inadequate for the large volume of food to be cooked.

Microbiology

Salmonella enteritidis PT 6B, isolated from the faeces of 42 of 49 camp members, was the only faecal pathogen isolated. Culture of the recovered foodstuffs, including direct and enriched culture of 6 of the remaining eggs, resulted in no growth of pathogens.

DISCUSSION

This serious outbreak of food poisoning among a group of campers under canvas resulted in significant morbidity to those affected, and distress to their families. Other costs were incurred by the Local Authority and District Health Authority (DHA) in Wales but, not least, in 33 Extra-Contractual Referrals (ECRs) incurred by the DHA in the camp residents' home town. It occurred near the site of an almost identical *Salmonella enteritidis* PT 4 camping outbreak, associated with the same food vehicle, 4 years previously. Fresh shell eggs, stored after purchase at ambient temperature, were the most likely source of infection, with multiplication during preparation and subsequent storage of the pie a significant contributory factor. The infecting organism, *Salmonella enteritidis* PT 6B, is a new phage type which was first defined at the LEP in August 1993. If agreement had been obtained to test the laying flocks, detection of this unusual phage type would have further strengthened the hypothesis.

This outbreak highlights the importance of current guidelines on the storage of eggs, particularly where the eggs are consumed uncooked or under-cooked. Guidelines on the transport, storage and preparation of foods while on camping holidays should be developed, evaluated and disseminated. Groups, such as campers, might benefit from such guidelines. Compliance with the ACMSF advice on the storage of eggs is difficult for campers [1]. Therefore they should consider the use of cold boxes for their transport and storage, and avoid the preparation of lightly cooked egg products under these basic conditions.

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